

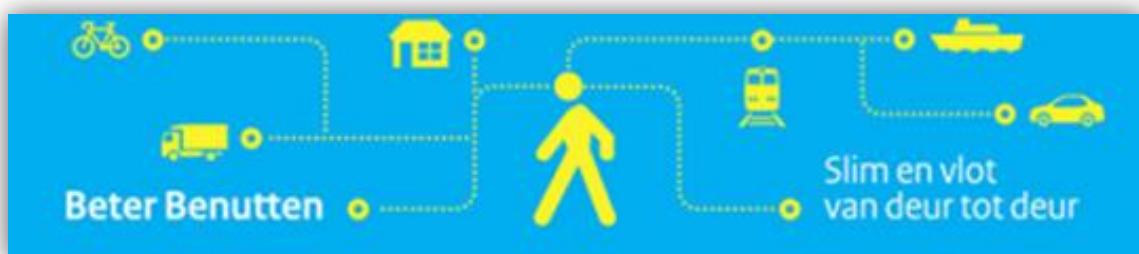
Innovatief Partnership

Talking Traffic

Software Test Description Interoperability iTLC (incl RIS)

Cluster 1

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1 Voorwoord

Dit document beschrijft de interoperabiliteitstest specificatie voor de iVRI (TLC, RIS en ITS applicatie).

Dit document is tot stand gekomen in samenwerking met de cluster 1 partners in het Innovatief Partnership Talking Traffic.



Koos van Vliet



Gert Hut

Yvo de Witte



Joost Nouwen

Jaap Zee



Arie Schreuders



Ron van Zuilichem

NB. De rest van dit document is geschreven in het Engels om internationale uitwisseling te ondersteunen.

The rest of this deliverable has been written in English to facilitate international exchange.

DOCUMENT CONTROL SHEET

Document Versions

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CONTENTS

1 VOORWOORD	2
2 INTRODUCTION	6
2.1 System overview	6
2.2 Document overview	6
2.2.1 Purpose	6
2.2.2 Document structure.....	6
2.3 Advise for the reader	6
3 REFERENCES	7
3.1 Normative	7
3.2 Informative	7
4 ACRONYMS, ABBREVIATIONS AND CONCEPTS	8
5 TEST SETUP	10
5.1 Device under test	10
5.2 Test tooling	10
5.2.1 TLEX simulator	10
5.2.2 TLC simulator(s)	11
5.2.3 IVERA client	11
5.2.4 V-Log client	11
5.2.5 TLC-FI exerciser	11
5.2.6 RIS-FI exerciser.....	11
5.2.7 NTP server	12
5.3 Test configuration	12
6 TEST EXECUTION	13
6.1 Introduction	13
6.2 Structure	13
6.3 Execution.....	13
6.3.1 Direct	13
6.3.2 Exploratory	13
6.3.3 Additional testing	13
6.4 Test case notation format	14
6.4.1 Remarks / actions	14
6.5 Test Readiness Review	14
7 TEST VERIFICATION & VALIDATION	16
7.1 Introduction	16
7.2 Verification	16
7.3 Validation.....	16
8 TEST SCENARIOS	17
8.1 Introduction	17
8.2 Product identification	17
8.2.1 Traffic light controller.....	17
8.2.2 ITS application (ITS-CLA).....	17
8.2.3 Road Side ITS Station.....	18
8.2.4 ITS-CRA	18
8.3 Test scenario 0: Smoke test	19

8.3.1	Smoke test	19
8.4	Test scenario 1: Normal operation	21
8.4.1	Start-up	21
8.4.2	Cyclic operation	23
8.5	Test scenario 2: CAM	24
8.5.1	Green on demand	24
8.5.2	Turn intention	27
8.6	Test scenario 3: SRM/SSM	29
8.6.1	Absolute priority for emergency vehicles	29
8.6.2	Conditional priority for public transport	34
8.6.3	Conditional priority for trucks.....	38
8.7	Test scenario 4: SPAT	41
8.7.1	Signal group states	41
8.7.2	Signal group predictions	42
8.7.3	Intersection states	43
8.7.4	Time exception ("Reden wachttijd")	45
8.8	Test scenario 5: DENM	47
8.8.1	ItsEvent	47
8.9	Test scenario 6: Exception handling	48
8.9.1	Disconnect the RIS	48
8.9.2	RIS influence	50
8.9.3	Disconnect the TLC.....	51
8.9.4	Disappearing vehicle (CAM)	52
8.10	Test scenario 7: Stress testing	53
8.10.1	Many CAM messages	53
8.10.2	Many SRM messages	55
8.11	Test scenario 8: GPS inaccuracy.....	57
8.11.1	GPS offset.....	57
8.11.2	GPS heading	59
8.12	Test scenario 9: EN50556.....	60
8.12.1	Power supply dips and voltage variations	60
8.13	Test scenario 10: User management	61
8.13.1	TLC user credentials	61
8.13.2	RIS user credentials	62
8.14	Test scenario 11: Timing and latency.....	63
8.14.1	SPAT latency	65
8.14.2	CAM latency	66
8.15	Test scenario 12: Security.....	67
8.15.1	RIS certificate	67
8.15.2	Trusted SRM/CAM	68
9	APPENDIX A: TEST RESULT OVERVIEW	70

2 Introduction

2.1 System overview

The iTLC architecture defines several interfaces of the iTLC. Figure 1 shows these interfaces.

See [Ref 20] for a description of the system overview. See [Ref 2] for a detailed architecture description.

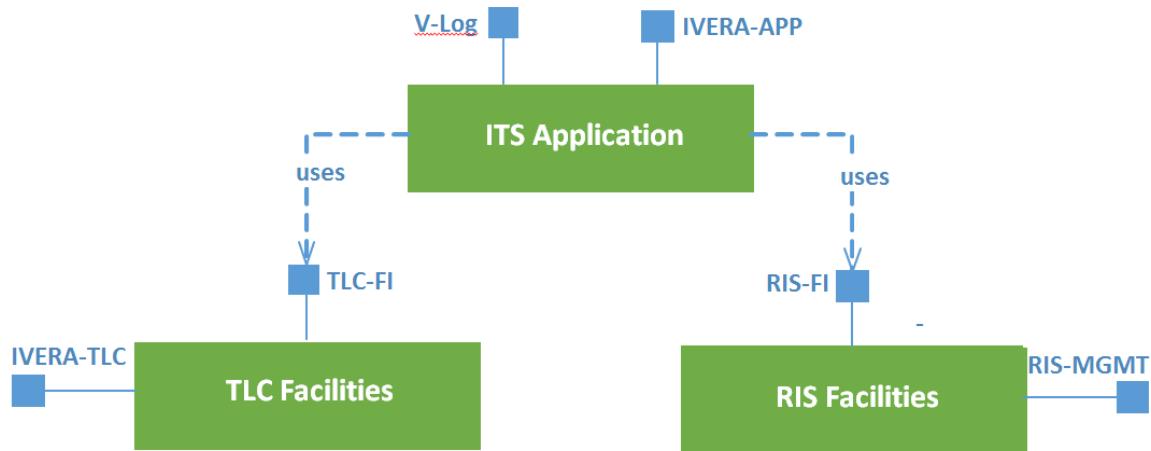


Figure 1 System overview

2.2 Document overview

2.2.1 Purpose

This document provides specifications for the testing the interoperability of the ITS control application, the TLC and RIS. This document is a part of a set of software test descriptions (STD's). Please refer to the Software Test Plan (STP) for a description of the test strategy [Ref 20].

2.2.2 Document structure

Chapter 3 contains references to normative and informative documents.

Chapter 4 explains acronyms and used definitions and concepts.

Chapter 5 outlines the test setup.

Chapter 6 outlines guidelines for the execution of the test scenarios.

Chapter 7 outlines guidelines for the interpretation of the test output.

Chapter 8 outlines the formal specification of the test cases.

2.3 Advise for the reader

It is advised that the reader has taken knowledge of the iTLC Architecture as described in [Ref 2] and the test strategy as described in [Ref 20].

[Ref 9] contains the STD for testing the interoperability between the ITS control application and the TLC. This STD describes (on top of [Ref 9]) additional test cases for testing the interoperability between the ITS-CLA, TLC and RIS.

3 References

3.1 Normative

ID	Reference
[ref 1]	Call for innovation partnerships for smarter urban and inter-urban mobility through intelligent services. (Versie: 1.1 datum: 21 juli 2016). Referentie nummer: BBV/2016/CALL/001
[ref 2]	Deliverable-F-iTLC-Architecture-v1.2.pdf
[ref 3]	iVRI2_del_1a_IDD_TLC-FI_v1.2.pdf
[ref 4]	iVRI2_del_1ab_IDD_Generic-FI_v1.1.pdf
[ref 5]	iVRI2_del_1b_IDD_RIS-FI_v1.2.pdf
[ref 6]	iVRI2_del_1d IRS security v1.1.pdf
[ref 7]	Del. G3 - IRSIDD iTLC Ivera4.00 v2.1.pdf
[ref 8]	iVRI2_del_3f iVRI test strategy v1_2.pdf
[ref 9]	iVRI2_del_3f_Interoperability_v1_1.pdf
[ref 10]	iVRI2_del_3f FAT test specification ITS-CLA v1_0.pdf
[ref 11]	iVRI2_del_3f FAT test specification TLC v1_0.pdf
[ref 12]	SWARCO iVRI Overnamepunt v2.2 20170929.pdf
[ref 13]	V-Log protocol en definities v3 0 1 - V2.6.2 (d.d. 01-11-2017)
[ref 14]	170629 CAM profile v1.2 [subWG NL profiel].docx
[ref 15]	170629 MAP profile v1.2 [subWG NL profiel].docx
[ref 16]	171116 ITF profile v2.0 [subWG NL profiel].docx 171116 ITF XML definition 2.0 [subWG NL profiel].xsd
[ref 17]	170629 SPAT profile v2.0 [subWG NL profiel].docx
[ref 18]	170629 SRM profile v1.2 [subWG NL profiel].docx
[ref 19]	170629 SSM profile v1.2 [subWG NL profiel].docx
[ref 20]	IPS-TT STP Cluster 1 v1_4.pdf
[ref 21]	170406 Besluit m.b.t. FCD Leveringsfrequentie WG Techniek - v1.0.pdf

3.2 Informative

ID	Reference

4 Acronyms, abbreviations and concepts

Acronyms and abbreviations

CAM	Cooperative Awareness Message
C-ITS	Cooperative ITS functionality for exchange of data between in-vehicle and or road side devices making use of either cellular or short range wireless communication
DENM	Decentralized Environmental Notification Message.
DSRC	Dedicated Short Range Communication message set (defined in SAE J2735:2016)
ETSI	European Telecommunications Standards Institute
GeoNetworking	Network layer protocol that provides packet routing in an ad hoc network based on geographic location, used in the IEEE 802.11p
IDD	Interface Design Description
IEEE 802.11p	IEEE standard for adding wireless access in vehicular environments to the WIFI protocol (WIFI-P), base of the ETSI ITS-G5
IRS	Interface Requirements Specification
iTLC (Dutch: iVRI)	Intelligent TLC performing traffic light controller and C-ITS functions and providing access to these functions for ITS applications
ITS	Intelligent Transport Systems
ITS-APP	ITS Application
ITS-CLA	ITS Control Application
ITS-CRA	ITS Consumer Application
ITS-PRA	ITS Provider Application
ITS G5	ITS messages broadcast over the 5GHz radio band supporting GeoNetworking, as specified by ETSI.
ITS Station	Functional entity specified by the ITS station reference architecture.
IVERA	Management protocol for traffic light controllers in the Netherlands
IVERA-APP	Management protocol for ITS applications.
IVERA-TLC	Management protocol supported by the TLC Facilities.
JSON	JavaScript Object Notation
KAR	Korte Afstand Radio. KAR is a wireless system for requesting priority at intersections.
LDM	Local Dynamic Map
MAP	Message to convey the current road topology to road-users, often used in conjunction with SPAT
RIS	Roadside ITS Station
RIS-FI	RIS Facilities Interface
RIS-MGMT	A manufacturer specific interface to manage a RIS.
R-ITS-S	Roadside ITS Station, responsible for C-ITS functionality within a geographical area.
SPAT	Signal Phase and Timing (message providing traffic light information).
SRM	Signal Request Message; a priority request.
SSM	Signal Status Message; the state of a priority request.
TLEX	Traffic Light EXchange platform
TLC	Traffic Light Controller; controls the signal of one or more intersections
TLC-FI	TLC Facilities Interface
TLS	Transport Layer Security
TMS	Traffic Management System
V-Log	V-Log is an open standard for datalogging in iTLC
WIFI-P	The IEEE 802.11p protocol

Concepts

ITS Control Application	A Traffic Control Application which uses TLC- and/or RIS-interfaces
ITS Application (ITS-APP)	An application which supports one or more ITS use-cases. Range of possible ITS Applications include an ITS Control Application
ItsEvent	Contains information about the occurrence of a traffic event, like weather conditions or dangerous situations.
RIS Facilities	Component providing RIS Facilities to users (internal and/or external). Includes amongst others: <ul style="list-style-type: none"> • Access to information stored in the LDM • Services to trigger C-ITS messages
TLC Facilities	Component providing facilities of a TLC to users (internal and/or external). Includes amongst others: <ul style="list-style-type: none"> • Access to information from the TLC • Services to trigger actuators
Verification and validation ¹	Verification and validation are independent procedures that are used together for checking that a product, service, or system meets requirements and specifications and that it fulfils its intended purpose.
Validation	The assurance that a product, service, or system meets the needs of the customer and other identified stakeholders.
Verification	The evaluation of whether or not a product, service, or system complies with a regulation, requirement, specification, or imposed condition.
Product supplier	In the iTLC context a supplier of iTLC's or iTLC components.
Product certifier ²	An independent organisation that certifies iTLC components.

¹ Source: https://en.wikipedia.org/wiki/Verification_and_validation

² Source: https://en.wikipedia.org/wiki/Product_certification

5 Test setup

5.1 Device under test

The device under test (DUT) is an iTLC consisting of a TLC, an ITS control application, a RIS and an ITS consumer application. The iTLC implements the IVERA-TLC, IVERA-APP, V-Log 3.0 and TLEX external interfaces.

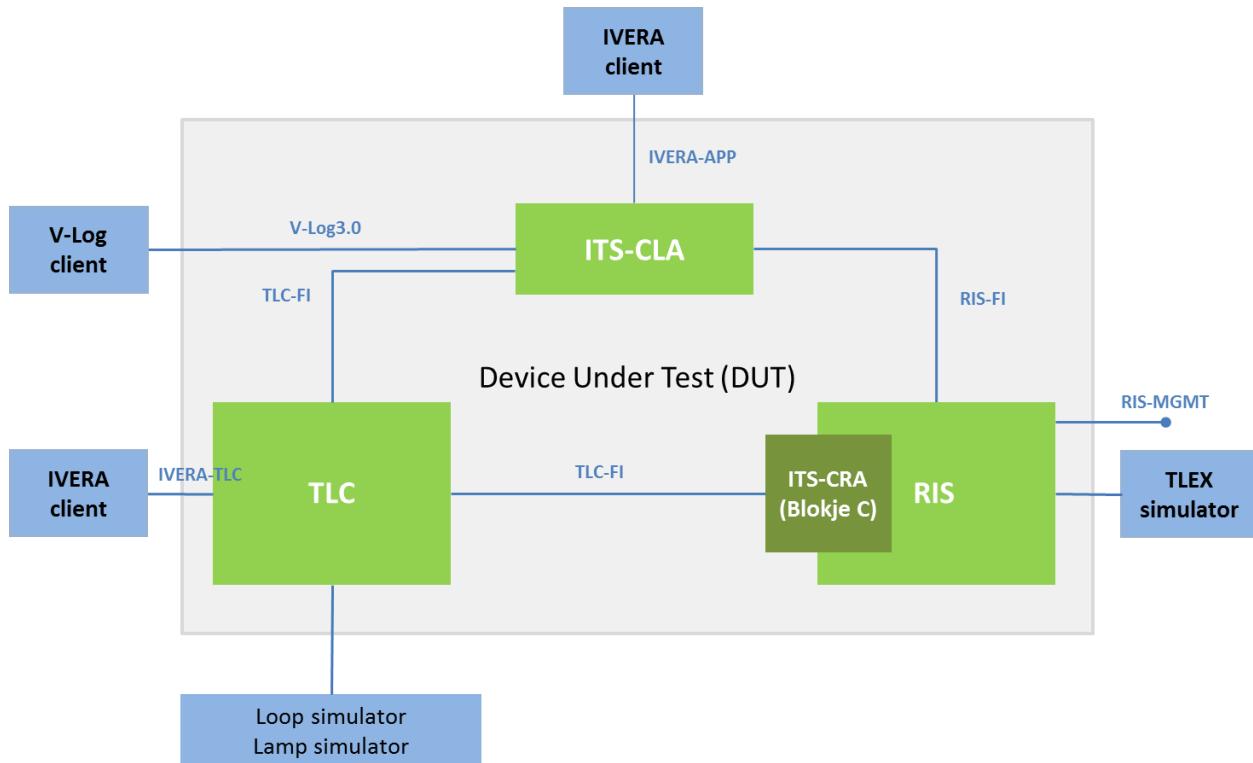


Figure 2: iTLC Device Under Test overview

Note: The ITS consumer application (ITS-CRA a.k.a 'blokje C') is an integral part of the RIS.

5.2 Test tooling

5.2.1 TLEX simulator

The TLEX simulator implements the TLEX TCP streaming protocol [Ref 12].

The TLEX simulator is used to generate CAM and SRM messages.

The TLEX simulator records/logs all messages send to and received from the iTLC.

The TLEX simulator is NTP time synchronised. The TLEX simulator timestamps all messages.

5.2.1.1 CAM message defaults

For generating CAM messages the following default values will be used unless stated otherwise in the test case:

heading:

- headingConfidence = 10 (1 degree)

speed:

- speedConfidence = 5 (cm/s)
- driveDirection = forward

vehicleLength:

- vehicleLengthValue = 50 (5 meter),
- vehicleLengthConfidenceIndication = noTrailerPresent (0)
- vehicleWidth = 20 (2 meter)

longitudinalAcceleration:

- longitudinalAccelerationValue = unavailable (161)
- longitudinalAccelerationConfidence = unavailable (102)

curvature:

- curvatureValue = 0
- curvatureConfidence = unavailable (7)
- curvatureCalculationMode = yawRateUsed (0)

yawRate:

- yawRateValue = straight (0)
- yawRateConfidence = unavailable (8)

Table 1 : Default CAM values

5.2.2 TLC simulator(s)

Connected to the TLC are simulators to simulate loop events and show the signal group and output status.

5.2.3 IVERA client

The IVERA client is used to interact with the TLC (IVERA-TLC) and the ITS-CLA (IVERA-APP).

The IVERA client implements the IVERA protocol [Ref 7].

5.2.4 V-Log client

The V-Log client implements the V-Log protocol [Ref 13].

The V-Log client records/logs the V-Log messages send by the iTLC.

5.2.5 TLC-FI exerciser

The TLC-FI exerciser implements the TLC-FI protocol [Ref 3].

The TLC-FI exerciser is provided by Dynniq.

5.2.6 RIS-FI exerciser

The RIS-FI exerciser implements the RIS-FI protocol [Ref 5].

The RIS-FI exerciser is provided by Swarco.

5.2.7 NTP server

The NTP server is a separate device on the network.

5.3 Test configuration

The test configuration is specified in Appendix A of the STP [Ref 20].

6 Test execution

6.1 Introduction

This chapter provides guidelines for the execution of the test scenarios specified in this document.

6.2 Structure

During a test the Device Under Test (DUT) is subjected to the documented test cases. This test specification is structured as follows:

- Test specification
 - o Test scenario(s)
 - Test case(s)
 - Test step(s)

6.3 Execution

The tests are executed in the documented order. No alterations should be made to the device under test during the test, unless explicitly documented.

The results are documented per test step.

A test step has passed if the pass criteria have been met.

A test step has failed if the pass criteria have not been met.

A test case has passed if all test steps have passed.

A test scenario has passed if all test cases have passed.

6.3.1 Direct

In several test cases the word direct or directly is used. This is to indicate a timely response to an event. For example when the dark button on the control panel is pressed, the iTLC shall switch off the signals directly. In case of doubt, the tester can measure the time and note the measured time in the remarks column. By default, the time is not measured unless time measurement is listed as an explicit action in the test step.

6.3.2 Exploratory

The tester decides how the test step is executed.

6.3.3 Additional testing

The iTLC is a complex system with several interfaces. This test specification aims to cover the basic operations and some common exceptions. On top of this test specification, there are many more combinations of events that could be verified or validated, however this is not practical. It is therefore left to the discretion of the tester(s) to assess if additional testing is required based on the outcome of the documented test cases.

6.4 Test case notation format

The following format is used to specify the test cases and document the test results.

Test Case:			
ID:			
Objective:			
Pre-conditions:			
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	Actions Verify		
2.			
3.			
Tested by:		Date:	

- Test case: A short description of the test case.
- ID: A unique ID
- Objective: The objective of the test case.
- Pre-conditions: The pre-conditions before the test case is executed.
- STEP: Number of the step.
- DESCRIPTION: A description of the actions to be executed and a description of the items to be verified.
- PASS/FAIL: The test result.
- REMARKS/ACTIONS: Remarks and actions related to the test results.
- Tested By: Person who executed the test case.
- Date: The date at which the test case was executed.

6.4.1 Remarks / actions

A remark shall be documented if:

- the test step does not meet the pass criteria;
- the test step cannot be executed;
- the test is interrupted;
- the test results are unusable;

6.5 Test Readiness Review

A Test Readiness Review (TRR) is held to verify readiness for formal interoperability type testing. The conditions are:

- The test configuration as specified in chapter 5 is available.
- A release version of the software is loaded in the iTLC components (TLC, ITS-CLA and RIS)
- The test intersection is configured in the TLC, ITS-CLA and RIS.
- The ITS-CLA supports the functional behaviour required for the documented test cases.
- The pre-conditions as documented in the test scenarios/test cases are met.
- The product identification tables are filled in.
- A pass on all test cases in the smoke test scenario.
- The components have been successfully submitted to the following tests:

- The ITS-CLA has passed the interoperability test [Ref 9].
- The TLC has passed the interoperability test [Ref 9].
- The RIS has passed the type test.
- The ITS-CLA has passed the type test.
- The TLC has passed the type test.

7 Test verification & validation

7.1 Introduction

This chapter provides guidelines on how to interpret the test output.

7.2 Verification

In several test cases there are steps to verify the functioning or performance of the iTLC. The tester verifies that the device under test reacts within the boundaries which are described in the tests.

7.3 Validation

In several test cases there are steps to validate the functioning or performance of the iTLC.

The tester validates if the system fulfils its intended purpose. Where applicable the tester performs exploratory testing to assess this. These steps typically require knowledge of the functional behaviour of the system and the outcome depends on the judgement of the person who executes the test case.

The tester(s) based on expert judgement fills in pass or fail. The tester(s) notes any issues/concerns in the remark/action column.

8 Test scenarios

8.1 Introduction

This chapter describes the test scenarios and the test cases per scenario.

8.2 Product identification

Please document below the relevant information of the product(s) under test.

8.2.1 Traffic light controller

Manufacturer		
Product		
Software release		
IVERA-TLC	TLS / VPN	
TLC-FI	TLS / VPN	
Backup program	Yes / No	Program number:
Pre-conditions (see section 6.5) met		
Remarks (if any)		

8.2.2 ITS application (ITS-CLA)

Manufacturer	
Product	
Software release	
Supports IVERA-APP	Yes/No
Supports V-Log3.0	Yes/No
Pre-conditions (see section 6.5) met	
Remarks (if any)	

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8.2.3 Road Side ITS Station

Manufacturer	
Product	
Software release	
RIS-FI	TLS / VPN
Pre-conditions (see section 6.5) met	
Remarks (if any)	

8.2.4 ITS-CRA

Manufacturer	
Product	
Software release	
Located in	Separate / RIS
Pre-conditions (see section 6.5) met	
Remarks (if any)	

8.3 Test scenario 0: Smoke test

This test scenario verifies that all components are operational and that all interfaces are available and accessible.

8.3.1 Smoke test

Test Case:	Smoke test		
ID:	SC0.SMO.01		
Objective:	Verify that the iTLC is operational and all interfaces are available and accessible		
Pre-conditions:	The system is switched on.		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<u>Verify</u> that the TLC is operational.		
2.	<u>Verify</u> that ITS-CLA is operational.		
3.	<u>Verify</u> that RIS is operational.		
4.	<u>Verify</u> that ITS-CRA is operational.		
5.	<u>Verify</u> that all components (TLC, ITS-CLA, ITS-CRA and RIS) are NTP synchronized.		
6.	<u>Verify</u> that an IVERA administrator user can login into the TLC. (Admin,AdminPassword)		
7.	<u>Verify</u> that an IVERA administrator user can login into the ITS-CLA. (iAdmin,iAdminPassword)		
8.	<u>Verify</u> that the V-Log client can setup a connection and receives V-Log3.0 output from ITS-CLA.		

9.	Verify that the connection with the TLEX exerciser has been established.		
10.	Verify that the (TLC-FI) connection between the ITS-CLA and TLC has been established using TLS.		
11.	Verify that the (TLC-FI) connection between the ITS-CRA and TLC has been established using TLS.		
12.	Verify that the (RIS-FI) connection between the ITS-CLA and RIS has been established using TLS.		
13.	Verify that the (RIS-FI) connection between the ITS-CRA and RIS has been established using TLS. Document N/A if the ITS-CRA is integrated in the RIS.		
Tested by:		Date:	

8.4 Test scenario 1: Normal operation

This test scenario is designed to verify and validate the normal operation of the iTLC.

8.4.1 Start-up

Test Case:		Start-up		
ID:		SC1.NO.01		
Objective:		Verify that the iTLC starts up correctly after power-up.		
Pre-conditions:		The TLC, RIS, ITS-CLA and ITS-CRA are switched off.		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	Switch-on the power for the DUT (TLC, RIS, ITS-CLA, ITS-CRA).			
2.	<u>Verify</u> that the intersection starts-up (amber flashing, steady amber, all red).			
3.	<u>Verify</u> that all signal groups remain in red (i.e. waiting in red).			
4.	Read the application logbook from the ITS-CLA (IVERA object APP.LB). <u>Verify</u> that based on the logbook entries the ITS-CLA has started up without errors.			
5.	<u>Verify</u> that there are no errors in the ITS-CLA (IVERA object APPFOUT).			
6.	Read the application logbook from the TLC (IVERA object VRI.LB).			

	Review the entries in the logbook. Verify that based on the logbook entries the TLC has started up without errors.		
7.	Verify (using the RIS-MGMT interface) that the RIS has started up and is operating without errors.		
8.	Verify that the ITS-CRA has started up and is operating without errors.		
Tested by:		Date:	

8.4.2 Cyclic operation

Test Case:		Cyclic operation		
ID:		SC1.NO.02		
Objective:		Verify that all signal groups are being served when all detectors are activated.		
Pre-conditions:		All signal groups are red and all detectors unoccupied.		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	<i>Note: The recorded V-Log3.0 output and SPAT messages are verified in test cases SC4.SPAT.01 and SC4.SPAT.02</i>			
2.	Activate all detectors (occupied)			
3.	<u>Verify</u> that all the signal groups are served. <i>Note: In which order the signal groups are served depends on the functional behaviour of the ITS Control application.</i>			
4.	<u>Verify</u> that the iTLC outputs SPAT messages.			
5.	<u>Verify</u> that the iTLC outputs the following V-Log3.0 messages <ul style="list-style-type: none"> - Message 13/14 ('Externe signaalgroep status') - Message 36 ('Fasecyclus timing') 			
6.	Monitor the system for at least 15 minutes. <u>Validate</u> that the iTLC functions as expected			
Tested by:		Date:		

8.5 Testscenario 2: CAM

This test scenario is designed to verify and validate the normal operation related to information received via CAM messages.

8.5.1 Green on demand

Test Case:		Green on demand		
ID:		SC2.CAM.01		
Objective:		Verify that ITS-CLA correctly interprets the vehicle positions reported by the RIS. Verify system behaviour with different CAM update frequencies, according [ref 21].		
Pre-conditions:		All detectors are inactive and all signal groups are showing red (i.e. waiting in red).		
STEP	DESCRIPTION	PASS / FAIL		REMARKS/ACTIONS
1.	Toggle detector d2. <u>Verify</u> that fc02 turns green and after the configured fixed green time turns to red (via amber).			
2.	<u>Test data: ETSI messages SC2.CAM.01.1</u> Wait until all signals show red (i.e. waiting in red). The TLEX simulator generates a sequence of CAM messages: <ul style="list-style-type: none"> - stationType is PassengerCar - role=Default - speed = 10m/s - Vehicle position is updated once per second. - Vehicle enters the network at the start of lane 1. - Vehicle departs the network via lane 10. 			
3.	<u>Verify</u> that fc02 turns green. <u>Verify</u> that all other signal groups remain red.			

4.	<p><u>Test data: ETSI messages SC2.CAM.01.2</u></p> <p>Wait until all signals show red (i.e. waiting in red).</p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none"> - stationType is LightTruck - role=Commercial - speed = 10m/s - Vehicle position is updated once per 2 seconds. - Vehicle enters the network at the start of lane 8. - Vehicle departs the network via lane 3. 		
5.	<p>Verify that fc08 turns green.</p> <p>Verify that all other signal groups remain red.</p>		
6.	<p><u>Test data: ETSI messages SC2.CAM.01.3</u></p> <p>Wait until all signals show red (i.e. waiting in red).</p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none"> - stationType is MotorCycle - role=Default - speed = 5m/s - Position is updated once per 5 seconds. - Vehicle enters the network at the start of lane 5. - Vehicle departs the network via lane 3. 		
7.	<p>Verify that fc05 turns green.</p> <p>Verify that all other signal groups remain red.</p>		
8.	<p><u>Test data: ETSI messages SC2.CAM.01.4</u></p> <p>Wait until all signals show red (i.e. waiting in red).</p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none"> - stationType is Cyclist 		

	<ul style="list-style-type: none"> - role=Default - speed = 4m/s - Position is updated once per 5 seconds. - Cyclist enters the network at the start of lane 24. - Cyclist departs the network via lane 29. 		
9.	<p><u>Verify</u> that fc21 turns green.</p> <p><u>Verify</u> that all other signal groups remain red.</p>		
10.	<p><u>Test data: ETSI messages SC2.CAM.01.5</u></p> <p>Wait until all signals show red (i.e. waiting in red).</p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none"> - stationType is PassengerCar - role=Default - speed = 10m/s - Position is updated once per second. - Vehicle enters the network at the start of lane 1. - Vehicle stops 110m before the stop line of fc02. 		
11.	<p><u>Verify</u> that all signal groups remain red.</p>		
12.	<p><u>Test data: ETSI messages SC2.CAM.01.6</u></p> <p>Wait until all signals show red (i.e. waiting in red).</p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none"> - stationType is PassengerCar - role=Default - speed = 10m/s - Position is updated once per second. - Vehicle enters the network at the start of lane 1. - Vehicle stops 90m before the stop line of fc02. 		
13.	<p><u>Verify</u> that fc02 turns green.</p>		

14.	Activate detector d5.		
15.	<u>Test data: ETSI messages SC2.CAM.01.7</u> The TLEX simulator keep sending a CAM message for the vehicle (defined in step 12) with speed = 0 m/s, once per 5 seconds. Verify that the iTLC keeps serving fc02 and fc05.		
16.	<u>Validate</u> the iTLC operation for 3 minutes (i.e. fc02 and fc05 being served).		
Tested by:		Date:	

8.5.2 Turn intention

Test Case:		Turn intention	
ID:		SC2.CAM.02	
Objective:		Verify that ITS-CLA correctly interprets the turn intention reported by the RIS.	
Pre-conditions:		All detectors are inactive and all signal groups are showing red (i.e. waiting in red).	
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<u>Because of implementation differences it is allowed to deviate from steps 2-10 by describing an alternative test case that supports the Objective.</u>		
2.	<u>Test data: ETSI messages SC2.CAM.02.1</u> Wait until all signals show red (i.e. waiting in red). The TLEX simulator generates a sequence of CAM messages: <ul style="list-style-type: none"> - stationType is PassengerCar - role=Default - speed = 10m/s - Vehicle position is updated once per second. - Vehicle enters the network at the start of lane 1. 		

	<ul style="list-style-type: none"> - Vehicle departs the network via lane 10. - exteriorLights = no signals. 		
3.	Verify that fc02 turns green.		
4.	Verify in the logging of the ITS-CLA the turnIntention of the vehicle (turnIntention = straight).		
5.	Repeat step 1 with: - exteriorLights = leftTurnSignalOn		
6.	Document which signal groups turn green (fc02 and/or fc03).		
7.	Verify in the logging of the ITS-CLA the turnIntention of the vehicle (turnIntention = left).		
8.	Repeat step 1 with: - exteriorLights = rightTurnSignalOn		
9.	Document which signal groups turn green (fc02 and/or fc03).		
10.	Verify in the logging of the ITS-CLA the turnIntention of the vehicle (turnIntention = right).		
Tested by:		Date:	

8.6 Test scenario 3: SRM/SSM

This test scenario is designed to verify and validate the normal operation related to SRM/SSM messages.

8.6.1 Absolute priority for emergency vehicles

Test Case:	Absolute priority for emergency vehicles		
ID:	SC3.SRM.01		
Objective:	Verify that the iTLC properly handles the priority SRM messages generated by emergency vehicles and generates correct SSM messages in response.		
Pre-conditions:	All detectors are inactive and all signal groups are showing red (i.e. waiting in red).		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<u>Validate</u> that the ITS-CLA functions as expected during the execution of this test case (i.e. fc05 turning green when expected, all other signal groups remaining red).		
2.	<p><u>Test data: ETSI messages SC3.SRM.01.1</u></p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none"> • stationType = PassengerCar • vehicleRole = Emergency • lightBarActivated = true • sirenActivated = true • speed = 5m/s • Position is updated once per second. • Vehicle enters the network at the start of lane 5. • Vehicle departs the network via lane 3. <p>The TLEX simulator generates an SRM message when the vehicle is 100m before the stop line of fc05.</p> <ul style="list-style-type: none"> • requestType = priorityRequest • requestID = 10 		

	<ul style="list-style-type: none"> • role=Emergency • subRole=requestSubRoleUnKnown • inBoundLane:Connection = (lane 5 -> lane 3). <p>The TLEX simulator generates an SRM message when the vehicle has passed the stop line of fc05.</p> <ul style="list-style-type: none"> • requestType = priorityCancellation • requestID = 10 		
3.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 10 • status = granted 		
4.	<p>Verify that fc05 turns green.</p>		
5.	<p>Document N/A in the steps 6 till 11 if the ITS-CLA grants priority to emergency vehicles irrespective of the role attributes (lightBarActivated, sirenActivated).</p>		
6.	<p>Repeat step 2 with:</p> <ul style="list-style-type: none"> • lightBarActivated = true • sirenActivated = false <p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 10 • status = granted 		
7.	<p>Verify that fc05 turns green.</p>		
8.	<p>Repeat step 2 with:</p> <ul style="list-style-type: none"> • lightBarActivated = false • sirenActivated = true <p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 10 		

	<ul style="list-style-type: none">• status = granted		
9.	Verify that fc05 turns green.		
10.	Repeat step 2 with: <ul style="list-style-type: none">• lightBarActivated = false• sirenActivated = false Verify that a correct SSM message is broadcasted. <ul style="list-style-type: none">• requestID = 10• status = rejected		
11.	Verify that fc05 turns green.		

12.	<p><u>Test data: ETSI messages SC3.SRM.01.2</u></p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none">• stationType = HeavyTruck• role=Emergency• lightBarActivated = true• sirenActivated = true• speed = 5m/s• Position is updated once per second.• Truck enters the network at the start of lane 5.• Truck stops 10 meter before the stop line and stays at that location for 70 seconds.• Truck departs the network via lane 3. <p>The TLEX simulator generates an SRM message when the truck is 50m before the stop line of fc05.</p> <ul style="list-style-type: none">• requestType = priorityRequest• role=Emergency• subRole=requestSubRoleUnKnown• requestID = 10• inBoundLane:Connection = (lane 5 -> lane 3). <p>The TLEX simulator generates an SRM message, every second, while the truck is approaching the stop line of fc05.</p> <ul style="list-style-type: none">• requestType = priorityRequestUpdate• role=Emergency• subRole=requestSubRoleUnKnown• requestID = 10• inBoundLane:Connection = (lane 5 -> lane 3). <p>The TLEX simulator generates an SRM message when the truck has passed the stop line of fc05.</p> <ul style="list-style-type: none">• requestType = priorityCancellation• requestID = 10		
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13.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 10 • status = granted 		
14.	<p>Verify that a correct SSM message is broadcasted in response to each SRM update message.</p> <ul style="list-style-type: none"> • requestID = 10 • status = granted 		
15.	<p>Verify that fc05 turns green.</p>		
16.	<p>Verify that after approximately 60 seconds the status changes to:</p> <ul style="list-style-type: none"> • status = maxPresence <p>Document N/A if the ITS-CLA does not support maxPresence.</p>		
17.	Repeat step 2.		
18.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 10 • status = reserviceLocked. <p>Document N/A if the ITS-CLA does not support reserviceLocked.</p>		
Tested by:		Date:	

8.6.2 Conditional priority for public transport

Test Case:		Conditional priority for public transport		
ID:		SC3.SRM.02		
Objective:		Verify that the iTLC properly handles the priority SRM messages generated by public transport vehicles and generates correct SSM messages in response (to a SRM message). Verify that the iTLC properly handles the role attributes for the PT vehicles.		
Pre-conditions:		All detectors are inactive and all signal groups are showing red (i.e. waiting in red).		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	<u>Validate</u> that the ITS-CLA functions as expected during the execution of this test case (i.e. fc02 and fc08 turning green when expected).			
2.	<u>Test data: ETSI messages SC3.SRM.02.1</u> The TLEX simulator generates a sequence of CAM messages. <ul style="list-style-type: none"> • stationType = Bus • role=Public Transport • role attributes <ul style="list-style-type: none"> ◦ PtActivationType = 3 ◦ Line nr PT = 102 ◦ Vehicle ID = 12025 ◦ Block nr = 7540 ◦ Journey nr = 28 ◦ Support journey nr = 58023 ◦ Company nr = 223 ◦ Occupancy = 89 • speed = 5m/s • Position is updated once per second. • Bus enters the network at the start of lane 1. • Bus departs the network via lane 10. 			

	<p>The TLEX simulator generates a SRM message when the bus is 200m before the stop line of fc02.</p> <ul style="list-style-type: none"> • requestType = priorityRequest • role=publicTransport • subRole= requestSubRole7 -- 'dienstregelingsrit' • routeName="OV-route 2" • transitStatus <ul style="list-style-type: none"> ◦ loading = false ◦ anADAuse = false ◦ aBikeLoad = false ◦ doorOpen = false ◦ charging = false ◦ atStopLine = false • requestID = 20 • inBoundLane:Connection = (lane 1 -> lane 10). <p>The TLEX simulator generates an SRM message when the bus has passed the stop line of fc02.</p> <ul style="list-style-type: none"> • requestType = priorityCancellation • requestID = 20 		
3.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 20 • status = granted 		
4.	<p><u>Test data: ETSI messages SC3.SRM.02.2</u></p> <p>The TLEX simulator generates a sequence of CAM messages:</p> <ul style="list-style-type: none"> • stationType = Tram • role=Public Transport • role attributes <ul style="list-style-type: none"> ◦ PtActivationType = 3 ◦ Line nr PT = 108 ◦ Vehicle ID = 18 		

	<ul style="list-style-type: none"> ○ Block nr = 58000 ○ Journey nr = 2 ○ Support journey nr = 5 ○ Company nr = 250 ○ Occupancy = 600 ● speed = 5m/s ● Position is updated once per second. ● Tram enters the network at the start of lane 8. ● Tram departs the network via lane 3. <p>The TLEX simulator generates a SRM message when the tram is 100m before the stop line of fc08.</p> <ul style="list-style-type: none"> ● requestType = priorityRequest ● requestID = 20 ● inBoundLane:Connection = (lane 8 -> lane 3). ● role=publicTransport ● subRole= requestSubRole2 -- 'tram' ● routeName="Tramlijn 8" ● transitStatus <ul style="list-style-type: none"> ○ loading = false ○ anADAuse = false ○ aBikeLoad = false ○ doorOpen = false ○ charging = false ○ atStopLine = false <p>The TLEX simulator generates a SRM message once per second</p> <ul style="list-style-type: none"> ● requestType = priorityRequestUpdate ● requestID = 20 <p>The TLEX simulator generates a SRM message when the tram has passed the stop line of fc08.</p> <ul style="list-style-type: none"> ● requestType = priorityCancellation ● requestID = 20 		
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5.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 20 • status = granted 		
6.	<p>Document N/A in steps 7 and 8 if the ITS-CLA grants priority irrespective of the role attributes.</p>		
7.	<p>Repeat step 1 with:</p> <ul style="list-style-type: none"> • role attributes: <ul style="list-style-type: none"> ◦ Line nr PT = 107 		
8.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 20 • status = rejected 		
9.	<p>Test data: ETSI messages SC3.SRM.02.3</p> <p>Exploratory testing to verify that the ITS-CLA correctly receives the attributes of the PT vehicles as included in the CAM/SRM messages by the TLEX simulator.</p> <ul style="list-style-type: none"> • Line nr PT • Vehicle ID • Block nr • Journey nr • Support journey nr • Company nr • Occupancy <p>Document which role attributes have been verified.</p>		
Tested by:		Date:	

8.6.3 Conditional priority for trucks

Test Case:		Conditional priority for trucks		
ID:		SC3.SRM.03		
Objective:		Verify that the iTLC properly handles the priority SRM messages generated by trucks vehicles and generates correct SSM messages in response. Verify that the iTLC properly handles the role attributes for the trucks.		
Pre-conditions:		All detectors are inactive and all signal groups are showing red (i.e. waiting in red).		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	<u>Validate</u> that the ITS-CLA functions as expected during the execution of this test case (i.e. fc03 turning green when expected).			
2.	<u>Test data: ETSI messages SC3.SRM.03.1</u> The TLEX simulator generates a sequence of CAM messages: <ul style="list-style-type: none"> • stationType = HeavyTruck • role=DangerousGoods • role attributes <ul style="list-style-type: none"> ◦ DangerousGoodsBasic = flammableGases • speed = 5m/s • Position is updated once per second. • Truck enters the network at the start of lane 1. • Truck departs the network via lane 6. The TLEX simulator generates a SRM message when the truck is 200m before the stop line of fc03. <ul style="list-style-type: none"> • requestType = priorityRequest • requestID = 30 • role= DangerousGoods • subRole=requestSubRoleUnKnown 			

	<ul style="list-style-type: none"> inBoundLane:Connection = (lane 1 -> lane 6). <p>The TLEX simulator generates a SRM message when the truck has passed the stop line of fc03.</p> <ul style="list-style-type: none"> requestType = priorityCancellation requestID = 30 		
3.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> requestID = 30 status = granted 		
4.	<p>Document N/A in the steps 5,6,7,8 if the ITS-CLA grants priority irrespective of stationType and/or role.</p>		
5.	<p>Repeat step 1 with:</p> <ul style="list-style-type: none"> stationType = LightTruck 		
6.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> requestID = 30 status = rejected 		
7.	<p>Repeat step 1 with:</p> <ul style="list-style-type: none"> role=RoadWork role attributes <ul style="list-style-type: none"> roadworksSubCauseCode = streetCleaning 		
8.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> requestID = 20 status = rejected 		

9.	<p><u>Test data: ETSI messages SC3.SRM.03.2</u></p> <p>Exploratory testing to verify that the ITS-CLA correctly receives the attributes of the trucks as included in the CAM/SRM messages by the TLEX simulator.</p> <ul style="list-style-type: none">• DangerousGoodsBasic• specialTransportType• roadworksSubCauseCode		
Tested by:		Date:	

8.7 Testscenario 4: SPAT

This test scenario is designed to verify and validate the normal operation related to SPAT messages.

8.7.1 Signal group states

Test Case:		Signal group states		
ID:		SC4.SPAT.01		
Objective:		[Ref 2] QA_SAFE_001: SPAT-payload shall be consistent with actual displayed images at traffic lights.		
Pre-conditions:		All detectors are inactive and all signal groups are showing red (i.e. waiting in red).		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	Toggle detector d2. <u>Verify</u> that fc02 turns green and after the configured fixed green time turns to red (via amber) <u>Verify</u> that the status of fc02 is correctly represented in the SPAT messages.			
2.	Repeat step 1 for all signal groups <ul style="list-style-type: none"> • d2 -> fc02 • d3 -> fc03 • d5 -> fc05 • d7 -> fc07 • d8 -> fc08 • dk-21 -> 21 • dk31_1 or dk31_2 -> 31 			
3.	Review the recorded output from SC1.NO.02 <u>Validate</u> that the signal group states (WUS) in the recorded V-Log3.0 output are identical to the signal group states in the recorded SPAT messages.			
Tested by:		Date:		

8.7.2 Signal group predictions

Test Case:		Signal group predictions		
ID:		SC4.SPAT.02		
Objective:		Verify the signal group predictions.		
Pre-conditions:		All detectors are inactive and all signal groups are showing red (i.e. waiting in red).		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	Review the recorded output from SC1.NO.02 <u>Validate</u> that the signal group predictions in the recorded V-Log3 output are identical to the signal group predictions in the recorded SPAT messages.			
2.	<u>Validate</u> all the generated predictions.			
Tested by:		Date:		

8.7.3 Intersection states

Test Case:		Intersection states	
ID:		SC4.SPAT.03	
Objective:		Verify the intersection status in the SPAT payload.	
Pre-conditions:		All detectors are inactive and all signal groups are showing red (i.e. waiting in red).	
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<p>Verify that the status of signal groups and the intersection is correctly represented in the SPAT messages</p> <ul style="list-style-type: none"> • trafficDependentOperation = true • fixedTimeOperation = false • standbyOperation = false • off = false • preemptIsActive = false • signalPriorityIsActive = false • failureFlash = false • failureMode = false • manualControlsEnabled = false • stopTimersActivated = false 		
2.	<p>Switch the intersection to amber flashing using the control panel on the TLC.</p> <p>Verify that the status of signal groups and the intersection is correctly represented in the SPAT messages.</p> <ul style="list-style-type: none"> • standbyOperation = true 		
3.	<p>Switch the intersection to dark using the control panel on the TLC.</p> <p>Verify that the status of signal groups and the intersection is correctly represented in the SPAT messages.</p> <ul style="list-style-type: none"> • off = true 		

4.	Switch the intersection to automatic control using the control panel on the TLC. Verify that the status of signal groups and the intersection is correctly represented in the SPAT messages during the switch-on procedure.		
5.	Activate fixation using the control panel on the TLC. Verify that the status of signal groups and the intersection is correctly represented in the SPAT messages. <ul style="list-style-type: none">• manualControlsEnabled = true		
6.	Switch the intersection to automatic control using the control panel on the TLC.		
Tested by:		Date:	

8.7.4 Time exception (“Reden wachttijd”)

Test Case:		Time exception (“Reden wachttijd”)	
ID:		SC4.SPAT.04	
Objective:		Verify the time exception in V-Log and SPAT.	
Pre-conditions:		All detectors are deactivated.	
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	Review the recorded output from SC1.NO.02		
2.	<u>Verify</u> that time exception (“reden wachttijd”) is not set during normal operation in the V-Log output.		
3.	<u>Verify</u> that time exception (“reden wachttijd”) is not set during normal operation in the SPAT messages.		
4.	<u>Because of implementation differences it is allowed to deviate from steps 5-9 by describing an alternative test case that supports the Objective.</u>		
5.	Set detector d2 and <u>verify</u> that fc02 turns green.		
6.	<u>Test data: ETSI messages SC3.SRM.01.1</u> The TLEX simulator generates a sequence of CAM messages <ul style="list-style-type: none"> • stationType = PassengerCar • vehicleRole = Emergency • lightBarActivated = true • sirenActivated = true • speed = 5m/s • Position is updated once per second. • Vehicle enters the network at the start of lane 5. • Vehicle departs the network via lane 3. 		

	<p>The TLEX simulator generates an SRM message when the vehicle is 100m before the stop line of fc05.</p> <ul style="list-style-type: none"> • requestType = priorityRequest • requestID = 10 • role=Emergency • subRole=requestSubRoleUnKnown • inBoundLane:Connection = (lane 5 -> lane 3). <p>The TLEX simulator generates an SRM message when the vehicle has passed the stop line of fc05.</p> <ul style="list-style-type: none"> • requestType = priorityCancellation • requestID = 10 		
7.	Verify that fc02 turns red and that fc05 turns green.		
8.	Verify that V-Log “Reden wachttijd – Hulpdienst ingreep bit(1)” is set for fc02 when fc02 turns red as result of the SRM request and that the bit is reset when the SRM request is cancelled.		
9.	Verify in the SPAT messages that <u>emergencyVehiclePriority(2)</u> is set for fc02 when fc02 turns red as result of the SRM request and that the information is cleared when the SRM requested is cancelled.		
Tested by:		Date:	

8.8 Testscenario 5: DENM

This test scenario is designed to verify and validate the normal operation related to DENM messages.

Note: This test scenario only applies if the ITS-CLA supports DENM functionality.

8.8.1 ItsEvent

Test Case:		ItsEvent		
ID:		SC5.DENM.01		
Objective:		Verify that ItsEvents generated by the ITS-CLA are correctly outputted as DENM message(s).		
Pre-conditions:				
STEP	DESCRIPTION	PASS / FAIL		REMARKS/ACTIONS
1.	Exploratory testing: Generate an ItsEvent in the ITS-CLA. <u>Verify</u> that the correct DENM message is outputted. Write N/A if the ITS-CLA does not support ItsEvents.			
Tested by:		Date:		

8.9 Testscenario 6: Exception handling

Verify that the iTLC correctly handles exceptions.

8.9.1 Disconnect the RIS

Test Case:		Disconnect the RIS		
ID:		SC5.EXC.01		
Objective:		Verify that appropriate actions are taken when the network connection with the RIS is lost		
Pre-conditions:		All detectors are activated and all signal groups are being served in a cyclic order.		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	Validate that during the execution of this test case the intersection remains operational (i.e. signal groups are being served in a cyclic order without disruption).			
2.	Disconnect RIS (unplug the network cable)			
3.	Verify that the disconnect is detected by the ITS-CLA and reported in the logbook (IVERA:APP.LB) and error status (IVERA:APPFOUT).			
4.	Reconnect the RIS			
5.	Verify that the connections are automatically re-established: <ul style="list-style-type: none">• ITS-CLA – RIS• RIS – TLEX simulator• ITS-CRA – RIS			
6.	Verify that the reconnect is detected by the ITS-CLA and reported in the			

	logbook (IVERA:APP.LB) and error status (IVERA:APPFOUT) is cleared.		
7.	Verify that the iTLC outputs SPAT messages.		
Tested by:		Date:	

8.9.2 RIS influence

Test Case:		RIS influence	
ID:		SC5.EXC.02	
Objective:		Verify that the ITS-CLA removes influence from the RIS when the connection with the RIS is lost.	
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red)	
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<u>Test data: ETSI messages: SC5.EXC.02.1</u> The TLEX exerciser generates one CAM message where a vehicle is positioned on lane 1 at 50 m before the stop line of fc02. <u>Verify</u> that fc02 turns to green.		
2.	Disconnect RIS (unplug the network cable) directly after fc02 turns to green. <u>Verify</u> that fc02 turns to red (within 5 minutes after unplugging) and stays red.		
3.	Wait 30 seconds and then reconnect RIS <u>Verify</u> that the connections are automatically re-established.		
4.	<u>Verify</u> that all signal groups remain red.		
5.	Repeat step 1		
Tested by:		Date:	

8.9.3 Disconnect the TLC

Test Case:		Disconnect the TLC		
ID:		SC5.EXC.03		
Objective:		Verify the content of the SPAT messages when the TLC is disconnected. Verify that the content of the SPAT messages is actually provided to the RIS by the ITS-CRA. Verify that iTLC outputs correct SPAT messages when the connection with the TLC is restored.		
Pre-conditions:		All detectors are activated and all signal groups are being served in a cyclic order.		
STEP	DESCRIPTION	PASS / FAIL		REMARKS/ACTIONS
1.	Disconnect the TLC (i.e. unplug the network cable).			
2.	<u>Verify</u> the payload of the SPAT messages. <ul style="list-style-type: none"> • intersectionState->status.noValidSPATisAvailableAtThisTime = true 			
3.	Reconnect the TLC.			
4.	<u>Verify</u> that the ITS-CRA gets connected to the TLC			
5.	<u>Verify</u> that ITS-CLA becomes the active control application and that the signal groups are served in cycle order.			
6.	<u>Verify</u> the payload of the SPAT messages. <ul style="list-style-type: none"> • intersectionState • signal group states 			
Tested by:		Date:		

8.9.4 Disappearing vehicle (CAM)

Test Case:		Disappearing vehicle (CAM)		
ID:		SC5.EXC.04		
Objective:		Verify that a vehicle that 'disappeared' no longer influences the iTLC.		
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red)		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	<p><u>Test data: ETSI messages: SC5.EXC.04.1</u></p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none"> - stationType is PassengerCar - role=Default - speed = 10m/s - Vehicle position is updated once per second. - Vehicle enters the network at the start of lane 1. - Vehicle 'disappears' 50 meters before the stop line of fc02 (i.e. TLEX simulator stops sending messages for this vehicle). 			
2.	<u>Validate</u> that fc02 turns green and then turns red and stays red.			
3.	<p>Use the diagnostics of the ITS-CLA to <u>verify</u> that the 'demand' for fc02 is cleared within 20 seconds after the last CAM message has been send by the TLEX simulator.</p> <p><i>Note: [Ref 21] specifies a minimum update frequency of 0.1Hz (i.e. at least one CAM message per 10 seconds).</i></p>			
Tested by:		Date:		

8.10 Test scenario 7: Stress testing

8.10.1 Many CAM messages

Test Case:		Many CAM messages		
ID:		SC7.ST.01		
Objective:		Verify that the iTLC correctly handles many ItsStation transmitting CAM messages to the iTLC. [Ref 12] Specifies the following maximums for CAM messages: 1/second/vehicle and 400/second/TLC		
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red)		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	<p><u>Test data: ETSI messages: SC7.ST.01.1</u></p> <p>The TLEX simulator generates the following CAM messages</p> <p>300 vehicles travelling east-> west (fc02)</p> <ul style="list-style-type: none"> • stationType is PassengerCar • role=Default • speed = 15m/s • Vehicle positions are updated once per second. • Vehicles enter the network at the start of lane 1 with a rate of 3600 veh/hour • Vehicles depart the network via lane 10. <p>300 vehicles travelling west-> east (fc08)</p> <ul style="list-style-type: none"> • stationType is PassengerCar • role=Default • speed = 15m/s • Vehicle positions are updated once per second. • Vehicles enter the network at the start of lane 8 with a rate of 3600 veh/hour • Vehicles depart the network via lane 3. 			

	<p>300 vehicles travelling east-> west on a trajectory 100m north of lane 1->10.</p> <ul style="list-style-type: none"> • stationType is PassengerCar • role=Default • speed = 33m/s • Vehicle positions are updated once per second. • Vehicles enter the network with a rate of 3600 veh/hour <p>300 vehicles travelling west->east on a trajectory 100m north of lane 8->3.</p> <ul style="list-style-type: none"> • stationType is PassengerCar • role=Default • speed = 33m/s • Vehicle positions are updated once per second. • Vehicles enter the network with a rate of 3600 veh/hour <p>Note: Each vehicle has a unique stationID. The vehicles driving north of the intersection represent vehicles on a nearby highway that should not be matched to the map of the intersection.</p>		
2.	<u>Validate</u> that the iTLC works as expected (i.e. giving green to fc02 and fc08).		
3.	<u>Verify</u> that the intersection reverts to waiting in red, once all vehicles have passed the stop lines		
4.	<p>Review the ITS-CLA logs (if available)</p> <p>Review the RIS logs (if available)</p> <p><u>Validate</u> that the iTLC has remained fully operational.</p>		
Tested by:		Date:	

8.10.2 Many SRM messages

Test Case:		Many SRM messages	
ID:		SC7.ST.02	
Objective:		Verify that the iTLC correctly handles many ItsStation transmitting SRM messages to the iTLC.	
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red)	
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<p><u>Test data: ETSI messages: SC7.ST.02.1</u></p> <p>The TLEX simulator generates the following CAM messages</p> <p>300 vehicles travelling east-> west (fc02)</p> <ul style="list-style-type: none"> • stationType is PassengerCar • role=Emergency • lightBarActivated = true • sirenActivated = true • speed = 15m/s • Vehicle positions are updated once per second. • Vehicles enter the network at the start of lane 1 with a rate of 1800 veh/hour • Vehicles depart the network via lane 10. <p>The TLEX simulator generates an SRM message when the vehicle is 100m before the stop line of fc02.</p> <ul style="list-style-type: none"> • requestType = priorityRequest • requestID = a unique value for each vehicle. • inBoundLane:Connection = (lane 1 -> lane 10). <p>The TLEX simulator generates an SRM message when the vehicle has passed the stop line of fc02.</p> <ul style="list-style-type: none"> • requestType = priorityCancellation 		

	<p>300 vehicles travelling west-> east (fc08)</p> <ul style="list-style-type: none"> • stationType is LightTruck • role=Emergency • lightBarActivated = true • sirenActivated = true • speed = 15m/s • Vehicle positions are updated once per second. • Vehicles enter the network at the start of lane 8 with a rate of 1800 veh/hour • Vehicles depart the network via lane 3. <p>The TLEX simulator generates an SRM message when the vehicle is 100m before the stop line of fc08.</p> <ul style="list-style-type: none"> • requestType = priorityRequest • requestID = a unique value for each vehicle. • inBoundLane:Connection = (lane 8 -> lane 3). <p>The TLEX simulator generates an SRM message when the vehicle has passed the stop line of fc08.</p> <ul style="list-style-type: none"> • requestType = priorityCancellation <p>Note: Each vehicle has a unique stationID.</p>		
2.	<p>Verify that correct SSM messages are outputted.</p> <p>Note: Priority should be rejected for all the vehicles.</p>		
3.	<p>Validate that the iTLC works as expected (i.e. giving green to fc02 and fc08).</p>		
4.	<p>Verify that the intersection reverts to waiting in red, once all vehicles have passed the stop lines.</p>		
5.	<p>Review the ITS-CLA logs (if available)</p> <p>Review the RIS logs (if available)</p> <p>Validate that the iTLC has remained fully operational.</p>		
Tested by:		Date:	

8.11 Test scenario 8: GPS inaccuracy

Verify that the iTLC handles inaccuracies in the provided GPS coordinates.

8.11.1 GPS offset

Test Case:	GPS offset	PASS / FAIL	REMARKS/ACTIONS
ID:	SC8.GPS.01		
Objective:	Verify that ItsStations with a small deviation in the position are still being matched to a lane. Verify that ItsStations with a larger deviation in the position are not matched to a lane.		
Pre-conditions:	All detectors are deactivated and all signal groups are red (i.e. waiting in red)		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<p><u>Test data: ETSI messages SC8.GPS.01.1</u></p> <p>The TLEX simulator generates a sequence of CAM messages</p> <ul style="list-style-type: none">- stationType is passengerCar- role=Default- speed = 10m/s- Position is updated once per second.- Vehicle enters the network at the start of lane 5.- Vehicle departs via lane 3.		
2.	<p><u>Verify</u> that fc05 turns green.</p> <p><u>Verify</u> that all other signal groups remain red.</p>		
3.	<p><u>Test data: ETSI messages SC8.GPS.01.2</u></p> <p>Repeat step 1 with the coordinates shifted 2.5 meter to the east.</p>		

4.	<p>Verify that fc05 turns green.</p> <p>Verify that all other signal groups remain red.</p>		
5.	<p><i>Test data: ETSI messages SC8.GPS.01.3</i></p> <p>Repeat step 1 with the coordinates shifted 30 meter to the east.</p>		
6.	<p>Verify that all signal groups remain red.</p>		
Tested by:		Date:	

8.11.2 GPS heading

Test Case:		GPS heading		
ID:		SC8.GPS.01		
Objective:		Verify that ItsStations with a small deviation in the heading are still being matched to a lane. Verify that ItsStations with a larger deviation in the heading are not matched to a lane.		
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red)		
STEP	DESCRIPTION	PASS / FAIL		REMARKS/ACTIONS
1.	<u>Test data: ETSI messages SC8.GPS.02.1</u> Repeat SC8.GPS.01 step 1 where 10 degrees is added to the heading.			
2.	<u>Verify</u> that fc05 turns green. <u>Verify</u> that all other signal groups remain red.			
3.	<u>Test data: ETSI messages SC8.GPS.02.1</u> Repeat SC8.GPS.01 step 1 where 180 degrees is added to the heading.			
4.	<u>Verify</u> that all signal groups remain red.			
Tested by:		Date:		

8.12 Test scenario 9: EN50556

This test scenario applies to an iTLC where TLC, RIS and ITS application are located inside the roadside cabinet.

8.12.1 Power supply dips and voltage variations

Test Case:		Power supply dips and voltage variations		
ID:		SC9.EN5.01		
Objective:		<p>The objective is to verify that a specific combination of TLC, RIS and ITS applications is resilient to power interruptions and mains voltage variations.</p> <p>Verify that a combination of individually tested components together (as a combination) meet the requirements outlined in the EN550556:2011.</p>		
Pre-conditions:				
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	Create power supply voltage dips in accordance with EN 50556:2011 section 6.6.5.			
2.	Perform an under voltage test in accordance with EN 50556:2011 section 6.6.2.			
3.	Perform a power up activation test in accordance with EN 50556:2011 section 6.6.3.			
Tested by:		Date:		

8.13 Test scenario 10: User management

8.13.1 TLC user credentials

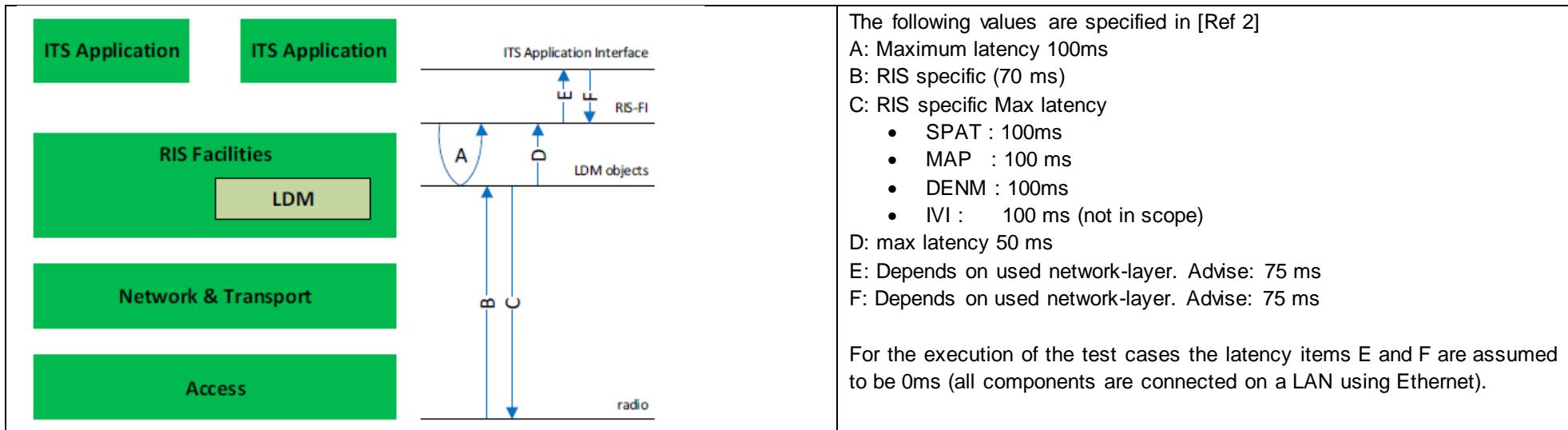
Test Case:		TLC user credentials		
ID:		SC10.USER.01		
Objective:		Verify that the ITS-CLA can login on the TLC as a different user. Verify that changes to the user credentials are persistent.		
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red)		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	<u>Connect to the ITS-CLA using IVERA-APP.</u> (iAdmin,iAdminPassword)			
2.	Change the settings for the TLC facilities: TLC#0="tlc-fis://Control2:Spec(%27~!%40%23%24%25%5E%26*_%2B-%%3D%7B%7D%5B%5D%3A%3B%3C%3E.%3F%2F)@192.168.10.10:11001"			
3.	<u>Verify</u> that the ITS-CLA disconnects from the TLC and reconnects as user Control2.			
4.	<u>Verify</u> the IVERA logbook entries in the ITS-CLA.			
5.	<u>Verify</u> the IVERA logbook entries in the TLC.			
6.	Power cycle the ITS-CLA.			
7.	<u>Verify</u> that the ITS-CLA connects to TLC as user Control2.			
Tested by:		Date:		

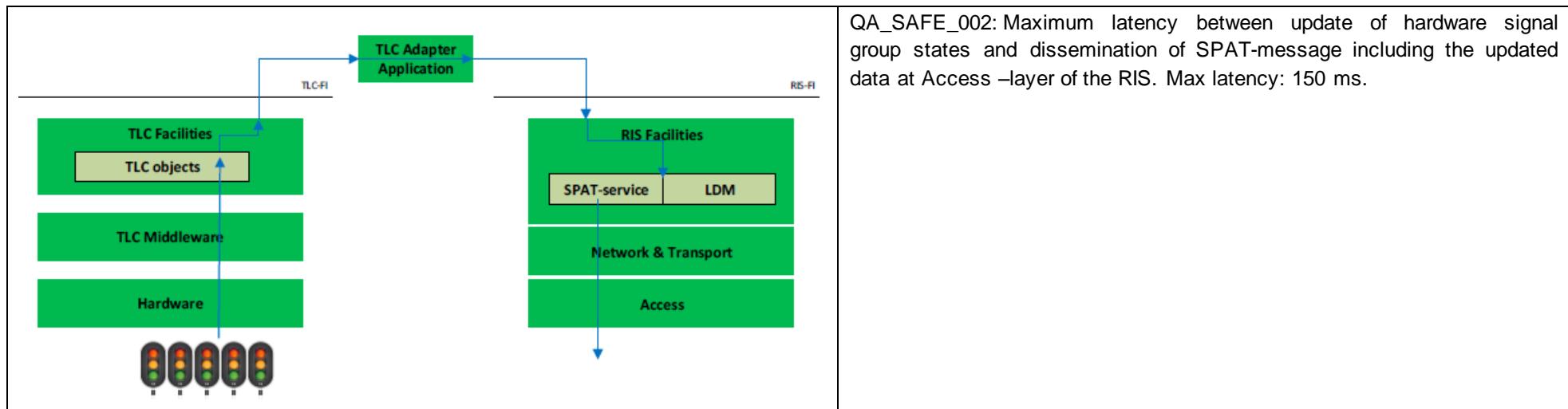
8.13.2 RIS user credentials

Test Case:		RIS user credentials	
ID:		SC10.USER.02	
Objective:		Verify that the ITS-CLA can login on the RIS as a different user.	
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red)	
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	<u>Connect to the ITS-CLA using IVERA-APP.</u> (iAdmin,iAdminPassword)		
2.	Change the settings for the RIS facilities: RIS/#0="ris-fis://Provider2:123456789012345678901234567890@192.168.10.60:12001"		
3.	<u>Verify</u> that the ITS-CLA disconnects from the RIS and reconnects as user Provider2.		
4.	<u>Verify</u> the IVERA logbook entries in the ITS-CLA.		
5.	<u>Verify</u> the logs in the RIS.		
Tested by:		Date:	

8.14 Test scenario 11: Timing and latency

Verify timing and latency as defined in [Ref 2] section 14. The figures below are copied from [Ref 2] for the ease of reference.





8.14.1 SPAT latency

Test Case:		SPAT latency			
ID:	SC11.TAL.01				
Objective:	Verify the timing requirement QA_SAFE_002.				
Pre-conditions:	All detectors are deactivated and all signal groups are red (i.e. waiting in red). (TLC and TLEX simulator has the same time)				
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS		
1.	<p>Toggle detector d2. <u>Verify</u> that fc02 turns green.</p>				
2.	<p>Measure(by TLC manufacturer) when the green bulb of fc02 is switched on (T1).</p> <p>Measure (by TLEX simulator) when the TLEX simulator receives the SPAT message with the signal state transition (T2)</p> <p>Calculate $T = T2 - T1$</p> <p>Document the values (T, T2 and T1).</p> <p>Verify that the calculated time (T) meets the latency requirement QA_SAFE_002 (i.e. $T \leq 150\text{ms}$)</p>				
3.	<p>Execute the measurement 10 times.</p> <p>Document the results and calculate minimum/average/maximum.</p>				
Tested by:		Date:			

8.14.2 CAM latency

Test Case:		CAM latency			
ID:	SC11.TAL.02				
Objective:	Verify that the response time of the iTLC to a demand (based on CAM message) remains consistent and within acceptable levels (and always < 20.000 ms).				
Pre-conditions:	All detectors are deactivated and all signal groups are red (i.e. waiting in red)				
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS		
1.	<p><u>Test data: ETSI messages: SC11.TAL.02.1</u></p> <p>The TLEX simulator generates one CAM message</p> <ul style="list-style-type: none"> - stationType is PassengerCar - role=Default - speed = 10m/s - Position 50 meter before stop line fc02 on lane 1. <p><u>Verify</u> that fc02 turns green.</p>				
2.	<p>Measure when the TLEX simulator sends the CAM message (T1)</p> <p>Measure when the green bulb of fc02 is switched on (T2).</p> <p><u>Calculate</u> $T = T2 - T1$</p> <p><u>Document</u> the values (T, T2 and T1).</p>				
3.	<p>Execute the measurement 10 times.</p> <p><u>Document</u> the results and calculate minimum/average/maximum.</p>				
Tested by:		Date:			

8.15 Test scenario 12: Security

This test scenario verifies that the security is correctly implemented.

8.15.1 RIS certificate

Test Case:		RIS certificate	
ID:		SC12.SEC.01	
Objective:		Verify that the system for the RIS certificates works properly	
Pre-conditions:			
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	Install the certificate of the TLC on the RIS. Power-up the system.		
2.	<u>Verify</u> that ITS-CLA detects that the certificate is invalid and closes the connection (without providing username/password to the RIS).		
3.	Re-install the correct/valid certificate on the RIS. Power-up the system.		
4.	<u>Verify</u> that the ITS-CLA connects to the RIS.		
Tested by:		Date:	

8.15.2 Trusted SRM/CAM

Test Case:		Trusted SRM/CAM		
ID:		SC12.SEC.02		
Objective:		Verify that the security envelopes on the CAM and SRM messages.		
Pre-conditions:		All detectors are deactivated and all signal groups are red (i.e. waiting in red) Private Key Infrastructure (PKI).		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS	
1.	<u>Validate</u> that the ITS-CLA functions as expected during the execution of this test case (i.e. fc05 turning green when expected, all other signal groups remaining red).			
2.	<u>Test data: ETSI messages SC12.SRM.01.1</u> The TLEX simulator generates a sequence of CAM messages with a security envelop with a valid digital signature. <ul style="list-style-type: none"> • stationType = PassengerCar • vehicleRole = Emergency • lightBarActivated = true • sirenActivated = true • speed = 5m/s • Position is updated once per second. • Vehicle enters the network at the start of lane 5. • Vehicle departs the network via lane 3. The TLEX simulator generates an SRM message with a valid security envelop when the vehicle is 100m before the stop line of fc05. <ul style="list-style-type: none"> • requestType = priorityRequest • requestID = 10 • role=Emergency 			

	<ul style="list-style-type: none"> • subRole=requestSubRoleUnKnown • inBoundLane:Connection = (lane 5 -> lane 3). <p>The TLEX simulator generates an SRM message with a valid security envelop when the vehicle has passed the stop line of fc05.</p> <ul style="list-style-type: none"> • requestType = priorityCancellation • requestID = 10 		
3.	<p>Verify that a correct SSM message is broadcasted.</p> <ul style="list-style-type: none"> • requestID = 10 • status = granted 		
4.	<p>Verify that fc05 turns green.</p>		
5.	<p>Verify in the logging of the ITS-application the trustState of the SRM and CAM message (trustState = trusted).</p>		
6.	<p>Repeat step 2 with a security envelop with an invalid digital signature on the CAM and SRM message.</p>		
7.	<p>Verify in the logging of the ITS-application the trustState of the SRM and CAM message (trustState = untrusted).</p>		
8.	<p>Verify that either:</p> <ul style="list-style-type: none"> - no SSM is broadcasted, or - a SSM message (requestID=10, status=rejected) is broadcasted. 		
9.	<p>Verify that fc05 remains red.</p>		
Tested by:		Date:	

9 Appendix A: Test result overview

Test case	Pass / Retest Fail / Yes or No N.A.	Notes
8.2.1		
8.2.2		
8.2.3		
8.2.4		
8.3.1		
8.4.1		
8.4.2		
8.5.1		
8.5.2		
8.6.1		
8.6.2		
8.6.3		
8.7.1		
8.7.2		
8.7.3		
8.7.4		

Test case	Pass / Fail	Retest / Yes or No	N.A.	Notes
8.8.1				
8.9.1				
8.9.2				
8.9.3				
8.9.4				
8.10.1				
8.10.2				
8.11.1				
8.11.2				
8.12.1				
8.13.1				
8.13.2				
8.14.1				
8.14.2				
8.15.1				
8.15.2				